

CLAIMS

What is claimed is:

1. A liquid crystal display (LCD) device having a pixel region and a peripheral region adjacent to the pixel region, comprising:

- 5 a silicon substrate;
- an insulating layer on the substrate;
- a first metal layer above the insulating layer, comprising
- an array of pixel electrodes in the pixel region, and
- a peripheral portion in the peripheral region having a plurality of openings therein
- 10 exposing portions of the insulating layer;
- a plurality of spacers on the exposed portions of the insulating layer in the peripheral region;
- a second metal layer between the first metal layer and the substrate, comprising
- a plurality of light shields beneath the openings in the peripheral portion of the
- 15 first metal layer, and
- a plurality of signal routing lines in the peripheral region; and
- a plurality of walls, each corresponding to a corresponding one of the plurality of openings and extending substantially between the second metal layer and the first metal layer.

- 20 2. The LCD device of claim 1, wherein each wall is substantially continuous around the corresponding opening.

3. The LCD device of claim 1, wherein the wall comprises an opaque material.

4. The LCD device of claim 1, wherein each of the plurality of light shields is an island.

5 5. The LCD device of claim 1, wherein each of the plurality of walls is on a
corresponding one of the light shields.

6. The LCD device of claim 1, further comprising third and fourth metal layers between
the second metal layer and the substrate, the third and fourth metal layers each including a
10 plurality of additional signal routing lines in the peripheral region.

7. The LCD device of claim 1, further comprising a plurality of spacers on the insulating
layer between the pixel electrodes in the pixel region.

15 8. The LCD device of claim 1, further comprising at least one spacer between the pixel
electrodes in the pixel region having a same height as at least one of the plurality of spacers in
the peripheral region.

9. A liquid crystal display (LCD) device having a pixel region and a peripheral region
20 adjacent to the pixel region, comprising:

a substrate;

an insulating layer on the substrate;

a first metal layer above the insulating layer, comprising

an array of pixel electrodes in the pixel region, and
a peripheral portion in the peripheral region having an opening therein;
a spacer in the opening in the first metal layer in the peripheral region;
a second metal layer between the first metal layer and the substrate; and
5 a wall beneath the opening in the first metal layer in the peripheral region and extending
substantially between the second metal layer and the first metal layer.

10. The LCD device of claim 9, wherein the wall is substantially continuous around the
opening.

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11. The LCD device of claim 9, wherein the second metal layer comprises a light shield
beneath the opening in the peripheral portion of the first metal layer, and wherein the wall
extends substantially between the light shield and the first metal layer.

15 12. The LCD device of claim 9, further comprising at least one spacer in the pixel region
having a same height as the spacer in the peripheral region.

13. The LCD device of claim 9, wherein the opening exposes a portion of the insulating
layer and wherein the spacer is on the exposed portion of the insulating layer.

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14. A liquid crystal display (LCD) device having a pixel region and a peripheral region
adjacent to the pixel region, comprising:

a substrate;

an insulating layer on the substrate;
a first metal layer above the substrate, comprising
an array of pixel electrodes in the pixel region, and
a peripheral portion in the peripheral region having an opening therein;
5 a spacer in the opening in the first metal layer in the peripheral region;
a second metal layer between the first metal layer and the substrate, comprising
a light shield beneath the opening in the peripheral portion of the first metal layer,
and
a plurality of signal routing lines in the peripheral region; and
10 third and fourth metal layers between the second metal layer and the substrate, the third
and fourth metal layers each including a plurality of additional signal routing lines in the
peripheral region.

15 15. The LCD device of claim 14, wherein the third and fourth metal layers form
mutually-orthogonal row and column lines for the LCD device.

16. The LCD device of claim 14, wherein the light shield is an island.

20 17. The LCD device of claim 14, further comprising at least one spacer in the pixel
region having a same height as the spacer in the peripheral region.

18. A method of producing a liquid crystal display (LCD) device having a pixel region
and a peripheral region adjacent to the pixel region, comprising:

forming an insulating layer on a substrate;

forming a first metal layer above the substrate;

forming a pixel metal layer above the first metal layer, the pixel metal layer comprising an array of pixel electrodes in the pixel region, and a peripheral portion in the peripheral region

5 having a plurality of openings therein exposing portions of the insulating layer; and

forming a plurality of walls, each corresponding to a corresponding one of the plurality of openings and extending substantially between the first metal layer and the peripheral portion of the pixel metal layer.

10 19. The method of claim 18, wherein forming the first metal layer comprises:

forming a plurality of light shields directly beneath the openings in the peripheral portion of the pixel metal layer, and

forming a plurality of signal routing lines in the peripheral region.

15 20. The method of claim 18, wherein each wall is formed substantially continuously around the corresponding opening.

21. The method of claim 18, wherein the wall is formed of an opaque material.

20 22. A liquid crystal display (LCD) device having a pixel region and a peripheral region adjacent to the pixel region, comprising:

a substrate;

an insulating layer on the substrate;

a first metal layer above the insulating layer, comprising

an array of pixel electrodes in the pixel region and a first plurality of recesses

therebetween, and

a peripheral portion in the peripheral region having a second plurality of recesses

5 therein; and

a plurality of spacers in the first plurality of recesses and the second plurality of recesses,
at least one of the spacers in the first plurality of recesses and at least one of the spacers in the
second plurality of recesses having a same height.